Model Hydrogen Fuel Cell Car Race Competition Rules

Purpose

The Department of Energy (DOE) and General Motors (GM) are very interested in ensuring that all students understand the hydrogen economy and how a fuel cell works. General Motors depends on an educated work force to succeed in an increasingly dynamic, technologically complex and competitive environment. The hydrogen fuel cell car competition engages sixth, seventh and eighth grade students to design, build and race model hydrogen-powered cars steered by guide wires. Each team is provided a fuel cell kit. Students are encouraged to use math and science principles, together with their creativity, in a fun, hands-on educational program that stimulates enthusiasm for science at a crucial stage in their education.

Hands-on design has a different feel from textbook problem solving or even traditional science labs. There is no single correct answer; any number of solutions developed by students can work. DOE and GM have found that students are excited about generating ideas in a group and then building and modifying models based on these ideas. Students can see for themselves how changes in design are reflected in car performance. Teachers/coaches will have the opportunity to guide their students through a process similar to those used by professional design engineers.

The goals of the program are as follows:

- Present science concepts in a fun and exciting way.
- Give students a chance to interact with engineers and scientists.
- Stimulate creative thinking through a hands-on design project.
- Help students to experience the satisfaction of creating a working machine and the excitement of entering it in a competition.

The objective of the hydrogen fuel cell car competition is to design and build a vehicle that will complete a race in the shortest possible time. The fuel cell enables you to produce hydrogen from a solar cell, a 6 volt battery, or an AC Adaptor. During the race the hydrogen will be used to produce electricity to power the car.

Teams use a fuel cell kit to design and build a hydrogen powered vehicle that will race on a 10-meter course. The winner of the competition will be the team whose vehicle is the top finisher in a series of head-to-head, double-elimination rounds. Awards will be given to the top three fastest cars.

NOTE: All cars must be built by the students with limited assistance from the coach or other adults. **This is a student competition!**

Race Components

There are two components to the race:

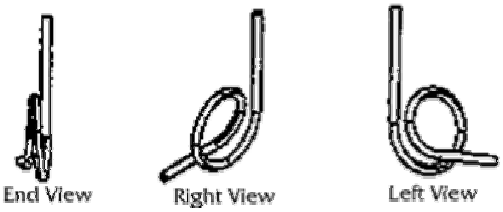
1. Speed race: Heats will be run in a series of head to head double elimination rounds until the top three cars have been identified. Student teams will be provided a fuel cell, motor, valves and some tubing. The rest of the car design and components will be up to the creativity and ingenuity of the students. They will need to design the chassis, gears, wheels, axles, hydrogen and oxygen gas collection system and electrical connection wires.
2. Hydrogen knowledge: Students must be able to answer a series of inquiry-based questions that test their knowledge of fuel cell and hydrogen technologies.

Materials

3. Fuel cell kits and a teacher activity guide will be provided to the 28 winning regional teams following their regional event. The regional winning teams *must* bring their completed hydrogen fuel cell car to the National event in Denver, Colorado, June 21-24, 2006. There will be materials and supplies at the National event for student teams to modify their cars on site.
4. The vehicle must be the team's design and can be altered using materials provided to the teams at the National Middle School Science Bowl.

Vehicle Specifications

5. The vehicle must be safe to contestants and spectators, e.g., no sharp edges, projectiles, etc.
6. The vehicle must fit the following dimensions: 30 cm. by 60 cm. by 30 cm.
7. Decals of the sponsor organizations (provided by National competition) must be visible from the side on the body of the car. A 3 cm. by 3 cm. space must be left for the assigned car number.
8. Energy Source: The electricity needed for the electrolysis procedure will be provided by a solar cell which will be charged using sunlight, an incandescent lamp, a 6 volt battery, or an AC Adaptor. The electrolysis will be completed in a designated charging area prior to the start of the race. The only energy source permitted on the vehicle is the fuel cell with the hydrogen that was produced from the electrolysis procedure.
9. Steering: An eyelet must be attached to the bottom front of the car. An example of a possible design is illustrated below. A guide wire, 1 cm. (+/- .05 cm) from the surface of the track, will go through the attached eyelets on the car, serving as the steering mechanism, and keeping the car in its lane. The vehicle must be easily removed from the guide wire, without disconnecting the guide wire. This is the only allowable method of steering the car. No radio control is permitted in the cars. Lane changing or crossing will result in disqualification.



Glue the eyelet to the bottom of your car near the front (or use two eyelets--one near the front and one near the rear). The guide wire will pass through the eyelet to keep your car in its lane.

Track Specifications

10. The length of the race course is 10 meters over flat terrain.
11. Race lanes are at least 60 cm. wide.
12. The guide wire will be located in the center of the track and will not be more than 1.5 cm. above the track surface.
13. The track is a hard, flat, smooth surface such as a tennis court or running track. A large sheet of rolled material, i.e., plastic, rubber, heavy paper, roofing paper (half-lap), or hardwood taped or bolted together may be used to cover an uneven surface.

Race Conduct

14. **Charging Station:** A solar cell, 6 volt battery, or AC Adaptor will be provided to supply the electricity needed for the electrolysis procedure. If direct sunlight is not available, incandescent lamps will be used with the solar cells to produce hydrogen to fuel the cars.
15. **Race Day Electrolysis Procedure:** Before the scheduled race start, all teams must report to the designated charging station with their hydrogen fuel cell car. Distilled water will be provided at the charging station for the electrolysis process. To manage the charging area, teams that are in the staging area and are scheduled to race in the next heat, will be given priority in the charging area. There is no time limit on the electrolysis procedure – a team may report to the charging station as early or late as practical; however, teams must be ready to start their race at the specified time. The only energy source permitted on the vehicle is the fuel cell with the hydrogen that it produced from the electrolysis procedure.
16. There will also be a repair table set up separate from the recharging area to help facilitate quick repairs to the cars. Again, teams that are scheduled to race in the next heat will be given priority in the repair area.
17. At race time, the vehicle will be placed behind the starting line with all its wheels in contact with the ground. No more than two team members will be allowed in the start area.
18. An early start or push start may result in disqualification or a re-run of the heat. The determination will be left to the race judges.

19. Six cars will be racing concurrently in three separate races. Cars will race in a head to head competition with one other vehicle. One car will advance to the No Loss and one car will in the Challenger's Bracket. All cars will race until they have lost two races. All vehicles will be started when the official signal is given. The winner of the heat will be the first vehicle to cross the finish line or the car farthest down the track when the race is called.
20. One team member must wait at the finish line to catch the vehicle.
21. Team members may not accompany or touch the vehicle on the track. Vehicles stalled on the track may be retrieved after the end of the race has been declared by the Lead Judge.
22. The vehicle and team member must remain at the finish line until the order of the race has been established.
23. Lane changing or crossing will result in disqualification.
24. Challenges must be made before the race judges begin the next heat. All challenges must come from the team members who are actively competing and directed to the lead judge. The decisions of the race judges are final.
25. Judges **will** inspect cars prior to the final heat or at anytime during/after heats.